

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Akira NAKAYAMA et al.

Application No.: 10/553,865

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For: BINDER FOR ELECTRODE OF LITHIUM
ION SECONDARY BATTERY

Examiner: J.J. Rhee

DECLARATION PURSUANT TO 37 C.F.R §1.132

Commissioner for Patents
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Sir:

I, Takao SUZUKI, declare and say as follows:

1. I am familiar with U.S. Application Serial No. 10/553,865, of which I am a co-inventor.
2. The following experiment was conducted either by myself or under my direct supervision.
3. This experiment demonstrates that the copolymer of Yamamoto (U.S. 6,756,153) does not exhibit a swelling degree of 4 or below in an electrolyte.

<Experimental report>

<OBJECT>

An object of this experimental report is to assess the swelling degree of binder described in the examples 3 and 7 of U.S. Patent No. 6,756,153 ('153) in an electrolyte, whose component of monomer is in the range of the present application.

<EXPERIMENT>

1. Polymerization of monomer

(Example 1)

Example 1 is corresponding to examples 3 and 7 of '153.

To 250 parts of water, 70 parts of butyl acrylate, 10 parts of acrylic acid, 15 parts of methacrylic acid, 5 parts of 1,3-butadiene, 3 parts of Sodium dodecylbenzenesulfonate and 0.3 parts of ammonium persulfate were added, and polymerization was conducted in a polymerization vessel at 60°C for 8 hours. Then, the content was cooled to room temperature, and an aqueous 5% sodium hydroxide solution was added to adjust the pH to 7 whereby a pH-adjusted latex was obtained.

Next, N-methylpyrrolidone (hereinafter, it may be abbreviated to NMP) as an organic liquid dispersion medium was added to the pH-adjusted latex. The mixture was evaporated by an evaporator under a reduced pressure with an aspirator at 80°C in a water bath until the water content becomes 800ppm, whereby a dispersion in NMP of polymer particles having a solid concentration of 13% was obtained.

In example 3 of '153, (A) an ethylenically unsaturated monomer soluble in NMP is butyl acrylate, (B) an ethylenically unsaturated monomer insoluble in NMP is acrylic acid, methacrylic acid, and 1,3-butadiene.

(Example 2)

Example 2 is corresponding to example 1 of the present application.

Into an autoclave with a stirrer, 400 parts of ion-exchange water, 26 parts of acrylonitrile, 5 parts of sodium dodecylbenzene

sulfonate and 3 parts of potassium persulfate were charged, and then the solution was sufficiently stirred. Thereafter, the solution was heated to 60°C to initiate polymerization at a first stage. When the polymerization conversion ratio reached 85%, thereto were added 48 parts of 2-ethylhexyl acrylate as a monomer for a second stage to continue the reaction. When the polymerization conversion ratio at the second stage reached 90%, thereto were added 26 parts of acrylonitrile as a monomer for a third stage. When the polymerization conversion ratio reached 99%, the solution was cooled to a room temperature, and lithium hydroxide was added to adjust the pH thereof to 7, where by a pH-adjusted latex was obtained.

Next, NMP was added thereto, and then water therein was volatilized with an evaporator to yield a dispersion of a polymer in NMP, having a solid concentration of 8%.

2. A swelling degree in an electrolyte

Aliquid obtained by dissolving or dispersing 0.2 g of the polymer in 10 mL of NMP was subjected to flow casting on a sheet made of polytetrafluoroethylene, and then dried to obtain a cast film. 4 cm² area piece of the cast film was cut out, and the weight thereof was measured. Thereafter, the piece of the cast film was immersed into an electrolyte of 60°C temperature. The immersed film was picked up after 72 hours, and then the electrolyte adhering on the film surface was wiped with a paper towel. Immediately, the weight of the film was measured. The value of (the weight after the immersion)/(the weight before the immersion) was defined as the swelling degree. As the electrolyte, there was used an electrolyte obtained by dissolving LiPF₆ in the concentration of 1 mole/liter into a solvent of 1:2 (volume ratio at 20°C) mixture of ethylene carbonate (EC) and diethyl carbonate (DEC).

<RESULT>

The result is shown in Table-1 below.

(Table-1)

	a swelling degree in an electrolyte
Example 1	5.1
Example 2	1.7

<DISCUSSION>

It is obvious that examples described in '153, whose component of monomer is in the range of the present application, exhibit a swelling degree of more than 4 in an electrolyte.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Takao Suzuki
Signature

Takao SUZUKI

Typed or Printed Name

08/05/2008
Date